IN THE CLAIMS:

1. (Original) A displacement difference dosimetry method for in-vivo measuring of dose rates within a radiation field, the method comprising the steps of:

a) providing a scintillating fiber having an insertion end and a coupling end;

b) coupling the coupling end of the scintillating fiber to a light intensity measuring device, the light intensity measuring device being located substantially outside of the radiation field and producing a voltage output in accordance with a measured light intensity from the scintillating fiber;

c) providing a guide channel having an insertion end and an external end;

d) inserting the insertion end of the guide channel into a human body to a region where radiation is to be measured, so as to provide a substantially fixed path into the human body;

e) inserting the insertion end of the scintillating fiber into the external end of the guide channel and into the human body along the substantially fixed path;

f) subjecting the region of the body at the insertion end of the scintillating fiber to radiation;

g) detecting the position ℓ of the insertion end of the scintillating fiber along the substantially fixed path within the human body and measuring the light intensity at the light intensity measuring device, with the measured light intensity representing both scintillation light from the scintillating fiber and also

Cerenkov light;

h) incrementally displacing the insertion end of the scintillating fiber by a small distance $\Delta\ell$ to a new detected position $\ell+\Delta\ell$ along the substantially fixed path and measuring the light intensity at the light intensity measuring device, with the measured light intensity representing both scintillation light from the scintillating fiber and also Cerenkov light;

i) determining a radiation dose rate, substantially free from the effects of Cerenkov light, for an incremental segment from ℓ to $\ell+\Delta\ell$ along the substantially fixed path according to the expression:

$$\text{Dose Rate} = C \times \Delta V/\Delta\ell,$$

where C is a coefficient, ΔV is the change in voltage output of the light intensity measuring device which results from the insertion end of the scintillating fiber being moved between the positions ℓ and $\ell+\Delta\ell$, and $\Delta\ell$ is the amount of incremental displacement.

2. (Original) The displacement difference dosimetry method as recited in claim 1, further including the step of:

using C=1 for the coefficient; and

using the Dose Rate expression to yield a relative dose rate.

3. (Original) The displacement difference dosimetry method as recited in claim 1, wherein the voltage output produced by the light intensity measuring device varies substantially linearly in accordance with the dose rate of radiation hitting the scintillating fiber, and the method further includes the steps of:

deriving the coefficient C as a calibration coefficient in an environment where the dose rate is known and where ΔV and $\Delta \ell$ in the Dose Rate expression can be sensed or detected; and

using the derived calibration coefficient for the coefficient C in the Dose Rate expression.

4. (Original) The displacement difference dosimetry method as recited in claim 1, wherein the guide channel is a catheter which is inserted into the human body.

5. (Original) The displacement difference dosimetry method as recited in claim 1, wherein the guide channel is a hypodermic needle which is inserted into the human body.

6. (Original) The displacement difference dosimetry method as recited in claim 1, wherein after the radiation dose rate for the incremental segment from ℓ to $\ell+\Delta\ell$ along the substantially fixed path has been determined, the following additional step is repeatingly performed to provide 1-dimensional radiation tomography:

j) incrementally displacing the insertion end of the scintillating fiber by an additional small distance, detecting the resulting change in position of the insertion end of the scintillating fiber and measuring the corresponding light intensity from the scintillating fiber at the light intensity measuring device, and determining a new radiation dose rate for an additional incremental segment along the substantially fixed path according to

the Dose Rate expression.

7. (Original) A displacement difference dosimetry method for in-vivo measuring of dose rates within a radiation field, the method comprising the steps of:

a) providing a scintillating fiber having an insertion end and a coupling end;

b) coupling the coupling end of the scintillating fiber to a light intensity measuring device, the light intensity measuring device being located substantially outside of the radiation field and producing a voltage output which varies substantially linearly in accordance with a dose rate of radiation hitting the scintillating fiber;

c) providing a guide channel having an insertion end and an external end;

d) inserting the insertion end of the guide channel into a human body to a region where radiation is to be measured, so as to provide a substantially fixed path into the human body;

e) inserting the insertion end of the scintillating fiber into the external end of the guide channel and into the human body along the substantially fixed path;

f) subjecting the region of the body at the insertion end of the scintillating fiber to radiation;

g) detecting the position ℓ of the insertion end of the scintillating fiber along the substantially fixed path within the human body and measuring the light intensity at the light intensity measuring device, with the measured light intensity representing

both scintillation light from the scintillating fiber and also Cerenkov light;

h) incrementally displacing the insertion end of the scintillating fiber by a small distance $\Delta\ell$ to a new detected position $\ell+\Delta\ell$ along the substantially fixed path and measuring the light intensity at the light intensity measuring device, with the measured light intensity representing both scintillation light from the scintillating fiber and also Cerenkov light;

i) determining a radiation dose rate, substantially free from the effects of Cerenkov light, for an incremental segment from ℓ to $\ell+\Delta\ell$ along the substantially fixed path according to the expression:

$$\text{Dose Rate} = C \times \Delta V/\Delta\ell,$$

where C is a coefficient, ΔV is the change in voltage output of the light intensity measuring device which results from the insertion end of the scintillating fiber being moved between the positions ℓ and $\ell+\Delta\ell$, and $\Delta\ell$ is the amount of incremental displacement.

8. (Original) The displacement difference dosimetry method as recited in claim 7, further including the step of:

using C=1 for the coefficient; and

using the Dose Rate expression to yield a relative dose rate.

9. (Original) The displacement difference dosimetry method as recited in claim 7, wherein the guide channel is a catheter which is inserted into the human body.

10. (Original) The displacement difference dosimetry method as recited in claim 7, wherein the guide channel is a hypodermic needle which is inserted into the human body.

11. (Original) The displacement difference dosimetry method as recited in claim 7, wherein after the radiation dose rate for the incremental segment from ℓ to $\ell+\Delta\ell$ along the substantially fixed path has been determined, the following additional step is repeatingly performed to provide 1-dimensional radiation tomography:

j) incrementally displacing the insertion end of the scintillating fiber by an additional small distance, detecting the resulting change in position of the insertion end of the scintillating fiber and measuring the corresponding light intensity from the scintillating fiber at the light intensity measuring device, and determining a new radiation dose rate for an additional incremental segment along the substantially fixed path according to the Dose Rate expression.

12. (Original) A displacement difference dosimetry method for in-vivo measuring of dose rates within a radiation field, the method comprising the steps of:

a) providing a scintillating fiber having an insertion end and a coupling end;

b) coupling the coupling end of the scintillating fiber to a light intensity measuring device, the light intensity measuring device being located substantially outside of the radiation field

and producing a voltage output which varies substantially linearly in accordance with a dose rate of radiation hitting the scintillating fiber;

c) providing a guide channel having an insertion end and an external end;

d) inserting the insertion end of the guide channel into a human body to a region where radiation is to be measured, so as to provide a substantially fixed path into the human body;

e) inserting the insertion end of the scintillating fiber into the external end of the guide channel and into the human body along the substantially fixed path;

f) subjecting the region of the body at the insertion end of the scintillating fiber to radiation;

g) detecting the position ℓ of the insertion end of the scintillating fiber along the substantially fixed path within the human body and measuring the light intensity at the light intensity measuring device;

h) incrementally displacing the insertion end of the scintillating fiber by a small distance $\Delta\ell$ to a new detected position $\ell+\Delta\ell$ along the substantially fixed path and measuring the light intensity at the light intensity measuring device;

i) determining a radiation dose rate for an incremental segment from ℓ to $\ell+\Delta\ell$ along the substantially fixed path according to the expression:

$$\text{Dose Rate} = C \times \Delta V/\Delta\ell,$$

where C is a coefficient, ΔV is the change in voltage output of the light intensity measuring device which results from the insertion

end of the scintillating fiber being moved between the positions ℓ and $\ell+\Delta\ell$, and $\Delta\ell$ is the amount of incremental displacement; and

after the radiation dose rate for the incremental segment from ℓ to $\ell+\Delta\ell$ along the substantially fixed path has been determined, repeatingly performing the following additional step to provide 1-dimensional radiation tomography:

j) incrementally displacing the insertion end of the scintillating fiber by an additional small distance, detecting the resulting change in position of the insertion end of the scintillating fiber and measuring the corresponding light intensity from the scintillating fiber at the light intensity measuring device, and determining a new radiation dose rate for an additional incremental segment along the substantially fixed path according to the Dose Rate expression.

13. (Original) The displacement difference dosimetry method as recited in claim 12, further including the step of:

using C=1 for the coefficient; and

using the Dose Rate expression to yield a relative dose rate.

14. (Original) The displacement difference dosimetry method as recited in claim 12, wherein the method further includes the steps of:

deriving the coefficient C as a calibration coefficient in an environment where the dose rate is known and where ΔV and $\Delta\ell$ in the Dose Rate expression can be sensed or detected; and

using the derived calibration coefficient for the coefficient

C in the Dose Rate expression.

15. (Original) The displacement difference dosimetry method as recited in claim 12, wherein the guide channel is a catheter which is inserted into the human body.

16. (Original) The displacement difference dosimetry method as recited in claim 12, wherein the guide channel is a hypodermic needle which is inserted into the human body.

Please add claims 17 to 34 as follows:

17. (New) A displacement difference dosimetry method for in-vivo measuring of dose rates within a radiation field, the method comprising the steps of:

a) providing a flexible scintillating fiber having an insertion end and a coupling end, the scintillating fiber having at least one cladding layer and a length of between 0.25 meters and 2.0 meters;

b) coupling the coupling end of the scintillating fiber to a light intensity measuring device, the light intensity measuring device being located substantially outside of the radiation field and producing a voltage output in accordance with a measured light intensity from the scintillating fiber;

c) providing a guide channel having an insertion end and an external end;

d) inserting the insertion end of the guide channel into a

human body to a region where radiation is to be measured, so as to provide a substantially fixed path into the human body;

e) inserting the insertion end of the scintillating fiber into the external end of the guide channel and into the human body along the substantially fixed path;

f) subjecting the region of the body at the insertion end of the scintillating fiber to radiation capable of producing Cerenkov light in the scintillating fiber while the coupling end of the scintillating fiber remains outside the human body and shielded from ambient light;

g) detecting an initial position ℓ of the insertion end of the scintillating fiber along the substantially fixed path within the human body, and measuring the light intensity at the light intensity measuring device, with the measured light intensity representing both scintillation light from the scintillating fiber and also Cerenkov light produced in the scintillating fiber when the insertion end is at the initial position;

h) storing in a processing circuit signals representative of the initial position ℓ of the insertion end of the scintillating fiber along the substantially fixed path within the human body, and the measured light intensity at the light intensity measuring device when the insertion end of the scintillating fiber is at the initial position;

i) incrementally displacing the insertion end of the scintillating fiber by a small distance $\Delta\ell$ to a new detected position $\ell+\Delta\ell$ along the substantially fixed path and measuring the light intensity at the light intensity measuring device, with the

measured light intensity representing both scintillation light from the scintillating fiber and also Cerenkov light produced in the scintillating fiber when the insertion end is at the new detected position;

j) in the processing circuit, determining a radiation dose rate, substantially free from the effects of Cerenkov light, for an incremental segment from ℓ to $\ell+\Delta\ell$ along the substantially fixed path according to the expression:

$$\text{Dose Rate} = C \times \Delta V/\Delta\ell,$$

where C is a coefficient, ΔV is a change in voltage output of the light intensity measuring device which results from the insertion end of the scintillating fiber being moved between the positions ℓ and $\ell+\Delta\ell$, and $\Delta\ell$ is the amount of incremental displacement.

18. (New) The displacement difference dosimetry method as recited in claim 17, wherein the flexible scintillating fiber is a single, continuous flexible scintillating fiber extending from the insertion end to the coupling end thereof.

19. (New) The displacement difference dosimetry method as recited in claim 17, wherein the voltage output produced by the light intensity measuring device varies substantially linearly in accordance with the dose rate of radiation hitting the scintillating fiber, and the method further includes the steps of:

deriving the coefficient C as a calibration coefficient in an environment where the dose rate is known and where ΔV and $\Delta\ell$ in the Dose Rate expression can be sensed or detected; and

using the derived calibration coefficient for the coefficient C in the Dose Rate expression.

20. (New) The displacement difference dosimetry method as recited in claim 17, wherein after the radiation dose rate for the incremental segment from ℓ to $\ell+\Delta\ell$ along the substantially fixed path has been determined, the following additional step is repeatingly performed to provide 1-dimensional radiation tomography:

j) incrementally displacing the insertion end of the scintillating fiber by an additional small distance, detecting the resulting change in position of the insertion end of the scintillating fiber and measuring the corresponding change in light intensity from the scintillating fiber at the light intensity measuring device, and determining a new radiation dose rate for an additional incremental segment along the substantially fixed path according to the Dose Rate expression.

21. (New) A displacement difference dosimetry method for in-vivo measuring of dose rates within a radiation field, the method comprising the steps of:

a) providing a flexible scintillating fiber having an insertion end and a coupling end, the flexible scintillating fiber having a diameter of between 0.25 mm and 1.0 mm;

b) coupling the coupling end of the scintillating fiber to a light intensity measuring device, the light intensity measuring device being located substantially outside of the radiation field

and producing a voltage output in accordance with a measured light intensity from the scintillating fiber;

c) providing a guide channel having an insertion end and an external end;

d) inserting the insertion end of the guide channel into a human body to a region where radiation is to be measured, so as to provide a substantially fixed path into the human body;

e) inserting the insertion end of the scintillating fiber into the external end of the guide channel and into the human body along the substantially fixed path;

f) subjecting the region of the body at the insertion end of the scintillating fiber to radiation capable of producing Cerenkov light in the scintillating fiber while the coupling end of the scintillating fiber remains outside the human body and shielded from ambient light;

g) detecting an initial position ℓ of the insertion end of the scintillating fiber along the substantially fixed path within the human body, and measuring the light intensity at the light intensity measuring device, with the measured light intensity representing both scintillation light from the scintillating fiber and also Cerenkov light produced in the scintillating fiber when the insertion end is at the initial position;

h) storing in a processing circuit signals representative of the initial position ℓ of the insertion end of the scintillating fiber along the substantially fixed path within the human body, and the measured light intensity at the light intensity measuring device when the insertion end of the scintillating fiber is at the

initial position;

i) incrementally displacing the insertion end of the scintillating fiber by a small distance $\Delta\ell$ to a new detected position $\ell+\Delta\ell$ along the substantially fixed path and measuring the light intensity at the light intensity measuring device, with the measured light intensity representing both scintillation light from the scintillating fiber and also Cerenkov light produced in the scintillating fiber when the insertion end is at the new detected position;

j) in the processing circuit, determining a radiation dose rate, substantially free from the effects of Cerenkov light, for an incremental segment from ℓ to $\ell+\Delta\ell$ along the substantially fixed path according to the expression:

$$\text{Dose Rate} = C \times \Delta V/\Delta\ell,$$

where C is a coefficient, ΔV is a change in voltage output of the light intensity measuring device which results from the insertion end of the scintillating fiber being moved between the positions ℓ and $\ell+\Delta\ell$, and $\Delta\ell$ is the amount of incremental displacement.

22. (New) The displacement difference dosimetry method as recited in claim 21, wherein the flexible scintillating fiber is a single, continuous flexible scintillating fiber extending from the insertion end to the coupling end thereof.

23. (New) The displacement difference dosimetry method as recited in claim 21, wherein the voltage output produced by the light intensity measuring device varies substantially linearly in

accordance with the dose rate of radiation hitting the scintillating fiber, and the method further includes the steps of:

deriving the coefficient C as a calibration coefficient in an environment where the dose rate is known and where ΔV and $\Delta \ell$ in the Dose Rate expression can be sensed or detected; and

using the derived calibration coefficient for the coefficient C in the Dose Rate expression.

24. (New) The displacement difference dosimetry method as recited in claim 21, wherein after the radiation dose rate for the incremental segment from ℓ to $\ell+\Delta\ell$ along the substantially fixed path has been determined, the following additional step is repeatingly performed to provide 1-dimensional radiation tomography:

j) incrementally displacing the insertion end of the scintillating fiber by an additional small distance, detecting the resulting change in position of the insertion end of the scintillating fiber and measuring the corresponding change in light intensity from the scintillating fiber at the light intensity measuring device, and determining a new radiation dose rate for an additional incremental segment along the substantially fixed path according to the Dose Rate expression.

25. (New) A displacement difference dosimetry method for in-vivo measuring of dose rates within a radiation field, the method comprising the steps of:

a) providing a flexible scintillating fiber having an

insertion end and an external end;

b) optically and mechanically coupling the external end of the scintillating fiber to a light intensity measuring device, the light intensity measuring device comprising a photomultiplier tube which is located substantially outside of the radiation field so as to produce a voltage output which varies in accordance with a dose rate of radiation hitting the scintillating fiber;

c) providing a guide channel having an insertion end and an external end;

d) providing a processing circuit;

e) inserting the insertion end of the guide channel into a human body to a region where radiation is to be measured, so as to provide a substantially fixed path into the human body;

f) inserting the insertion end of the scintillating fiber into the external end of the guide channel and into the human body along the substantially fixed path;

g) subjecting the region of the body at the insertion end of the scintillating fiber to radiation while the external end of the scintillating fiber remains outside the human body, the external end of the scintillating fiber being shielded from ambient light;

h) detecting an initial position ℓ of the insertion end of the scintillating fiber along the substantially fixed path within the human body and sending an initial position signal to the processing circuit;

i) measuring the light intensity emanating from the external end of the flexible scintillating fiber at the light intensity measuring device when the insertion end is at the initial position,

and sending a voltage output from the light intensity measuring device to the processing circuit;

j) storing the initial position signal and the corresponding voltage output from the light intensity measuring device in the processing circuit;

k) incrementally displacing the insertion end of the scintillating fiber by a small distance $\Delta\ell$ to a new detected position $\ell+\Delta\ell$ along the substantially fixed path and measuring the light intensity at the light intensity measuring device;

l) in the processing circuit, determining a radiation dose rate for an incremental segment from ℓ to $\ell+\Delta\ell$ along the substantially fixed path according to the expression:

$$\text{Dose Rate} = C \times \Delta V/\Delta\ell,$$

where C is a coefficient, ΔV is the change in voltage output of the light intensity measuring device which results from the insertion end of the scintillating fiber being moved between the initial position ℓ and the new detected position $\ell+\Delta\ell$, and $\Delta\ell$ is the amount of incremental displacement; and

after the radiation dose rate for the incremental segment from ℓ to $\ell+\Delta\ell$ along the substantially fixed path has been determined, repeatingly performing the following additional step to provide 1-dimensional radiation tomography:

m) incrementally displacing the insertion end of the scintillating fiber by an additional small distance, detecting the resulting change in position of the insertion end of the scintillating fiber and measuring the corresponding change in light intensity from the scintillating fiber at the light intensity

measuring device, and determining a new radiation dose rate for an additional incremental segment along the substantially fixed path according to the Dose Rate expression.

26. (New) The displacement difference dosimetry method as recited in claim 25, wherein the voltage output produced by the light intensity measuring device varies substantially linearly in accordance with the dose rate of radiation hitting the scintillating fiber, and the method further includes the steps of:

deriving the coefficient C as a calibration coefficient in an environment where the dose rate is known and where ΔV and $\Delta \ell$ in the Dose Rate expression can be sensed or detected; and

using the derived calibration coefficient for the coefficient C in the Dose Rate expression.

27. (New) The displacement difference dosimetry method as recited in claim 1, wherein the step of providing the scintillating fiber further includes:

providing the scintillating fiber with at least one cladding layer for greatly reducing a loss of light within the scintillating fiber.

28. (New) The displacement difference dosimetry method as recited in claim 7, wherein the step of providing the scintillating fiber further includes:

providing the scintillating fiber with at least one cladding layer for greatly reducing a loss of light within the scintillating

fiber.

29. (New) The displacement difference dosimetry method as recited in claim 12, wherein the step of providing the scintillating fiber further includes:

providing the scintillating fiber with at least one cladding layer for greatly reducing a loss of light within the scintillating fiber.

30. (New) The displacement difference dosimetry method as recited in claim 21, wherein the step of providing the flexible scintillating fiber further includes:

providing the flexible scintillating fiber with at least one cladding layer for greatly reducing a loss of light within the scintillating fiber.

31. (New) The displacement difference dosimetry method as recited in claim 25, wherein the step of providing the flexible scintillating fiber further includes:

providing the flexible scintillating fiber with at least one cladding layer for greatly reducing a loss of light within the scintillating fiber.

32. (New) The displacement difference dosimetry method as recited in claim 1, wherein the step of subjecting the region of the body at the insertion end of the scintillating fiber to radiation further includes:

subjecting the region of the body at the insertion end of the scintillating fiber to radiation while the coupling end of the scintillating fiber remains outside the human body and shielded from ambient light.

33. (New) The displacement difference dosimetry method as recited in claim 7, wherein the step of subjecting the region of the body at the insertion end of the scintillating fiber to radiation further includes:

subjecting the region of the body at the insertion end of the scintillating fiber to radiation while the coupling end of the scintillating fiber remains outside the human body and shielded from ambient light.

34. (New) The displacement difference dosimetry method as recited in claim 12, wherein the step of subjecting the region of the body at the insertion end of the scintillating fiber to radiation further includes:

subjecting the region of the body at the insertion end of the scintillating fiber to radiation while the coupling end of the scintillating fiber remains outside the human body and shielded from ambient light.